Appendix D

those based on barium and/or zirconium and preferably the alloys Ba-Li as disclosed in the European Patent Application No. 92830186 in the name of the same applicant, in particular the alloy having raw formula $BaLi_4$.

In other more detailed words the new improved process allows to evacuate and to make ready a thermal insulating jacket of a cryogenic device (dewar, transfer or storage pipings and so on) for the storage and/or the transport of a stuff which has to be kept at a temperature different from room temperature, in particular lower. Such a process allows to sorb the gases originated during the same process and during the subsequent life of the cryogenic device, by combining the action of a particular (chemical) water adsorbing agent, prevailingly acting in the first stages of the process (by providing a water pumping "in situ", which accelerates the same process) along with the action of a getter, activated only in a subsequent step, which is prevailingly acting as a chemical sorbing material with respect to the other gases different from water, like for instance O_2, N_2, CO, H_2, etc.

The invention is hereinafter described more clearly with reference to the following drawings, which are supplied for merely illustrating purposes, without limiting in any way the scope of the same invention, in which:

FIG. 1 shows a schematic sectional view of a commonly used metal dewar for the storage of liquefied gases, having an insulating jacket according to the invention;

FIG. 2 shows a graph reporting the results of the tests carried out by means of said dewar of FIG. 1;

FIG. 3 shows a preferred arrangement of the drying agent and of the getter inside the vacuum jacket;

FIG. 4 shows a schematic sectional view of a commonly used metal pipe, for the transportation of liquified gases, having an insulation jacket evacuated according to the invention; and

FIG. 5 shows a graph reporting the results of the tests carried out by means of the metal pipe of FIG. 4.

The series of operations hereinbelow, embodying the process according to the invention, is described referring to a vessel like the dewar of FIG. 1.

As it is known, the dewar 1 consists of an inner container or vessel 2, preferably made from metal, e.g. steel, defining an inner volume or useful space 3, suitable to contain a liquefied gas, which can communicate with the surroundings by means of a "neck" 6, normally closed but not sealed. An outer wall or mantel 4 defines, along with the inner wall 2, a jacket 5, partially filled, at least in the portion surrounding the inner wall 2, with an insulating material 9, preferably the "multilayer" type herein above. The jacket 5 can communicate with an outer pumping system (not shown in the drawings) by means of a connecting fitting 8 and a valve 7 for switching off or disabling the pump.

According to the present invention, there are inserted in the jacket 5 a chemical moisture adsorber 10 and a gettering material (11) (and optionally, in certain cases pointed out hereinabove, a hydrogen converter) lying in separate zones, against the outer wall 4, contrary to the known prior art, describing the getter material to be positioned against the inner wall, at a lower temperature. Then a first pumping step of the jacket 5 starts, through the tubular fitting 8, until reaching a pressure of 100 Pa or lower, which is anyhow requiring only a few minutes. The valve 7 is subsequently closed, thus isolat-

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A thermally insulating jacket, comprising:
at least one gas impermeable wall that defines an insulating compartment that can be evacuated so as to form a vacuum;
an insulating material filling the insulating compartment;
the insulating compartment including a getter material that is able to absorb both water vapor and at least a second type of gas or vapor from the insulating compartment;
the compartment also including a water sorbing material for sorbing the water vapor;

ing the vessel wall from the pumping apparatus, and the water sorbing material 10 exerts, for a time between 2 and 48 h, a selective pumping action with respect to the water vapor outgassed from the insulating material 9.

During this step, the valve 7 can be also kept open all along said induction time. In such a case, however, the drying material 10 is always sorbing the most part of the water vapor, because the action of the pump is limited by the flow conductance allowed by connection pipe fitting 8. Again in this phase of water vapor sorption (with or without any pumping from outside) the inner wall 2 can undergo a smooth heating, not above 150° C., for istance by penetration into the space 3 of hot air or of hot water, in order to accelerate the removal of the water vapor from insulating material 9, in particular from the innermost layers, lying near the wall 2, more than the other layers.

After the induction time, pumping is started again, should it have been disabled, by re-opening the valve 7, down to a pressure of 5 Pa or less. At this point the getter 11 is activated, e.g. by means of a heat generating device arranged at the outside, at a location corresponding to the inside positioning of the same getter. The heating can simply occur by using a flame, a hot air gun, an electric resistance or other similar means. The temperature to be reached depends on the kind of getter selected for the use. Getters which can be activated at a low or very low temperature are preferred, like the Ba-Li alloys disclosed in the European Patent Application No. 92830186, inserted in a blister supplied with a thermoretractable cover, according to the European Patent Application No. 92830185 also in the name of the same Applicant. Getter materials of this kind do not require a heating at a temperature higher than 120° C. in order to be activated.

Eventually, during the last step of the process, the jacket 5 is definitely isolated from the outside by closure of the valve 7, isolation of the pump and sealing (e.g. by means of a "pinch-off") in correspondence to the tubular fitting 8.

The same getter is working in a much better way if the sorbed gas does not contain water. This is the reason why it is suggested to let the gases get into contact first with the powerful drying agent, such as BaO (and optionally with a hydrogen converter), and then, in a separate zone, with the getter, e.g. Ba Li4.

More in detail, and according to the embodiment of FIG. 3, said chemical drying agent 10 and said getter 11 can be arranged in a container 12 subdivided into an inner and an outer zone by a porous septum 13, wherein the inner zone 14 contains said getter; the outer zone 15 is communicating with the space containing said insulating material 9 and contains said chemical drying agent 10, which prevents the passage of the water vapour through said septum and towards said getter 11.

Container 12 may be vertical box having an opening at its top and a planar (e.g. horizontal) septum or a toroidal box, wrapping for instance the inner vessel of a dewar or of a cryogenic piping, having a radial or a planar (e.g. horizontal) septum.

The same container can be also a rigid, semirigid or flexible box, made from a substantially water-free material, preferably from metal, glass, ceramics or combinations thereof. It may have a toroidal shape, but also different shapes in cross section could be adopted, e.g. circular, square, rectangular, triangular, elliptical, oval, lobe-shaped and of similar configuration.

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the insulating compartment including a getter material that is able to absorb both water vapor and at least a second type of gas or vapor from the compartment;
the compartment also including a water sorbing material for sorbing the water vapor;
a container for the getter and water sorbing material positioned in the compartment, the container being divided into upper and lower chambers and being made of a material that is impervious to water vapor,
the getter material being positioned in the lower chamber and the water absorber filling the upper chamber;
the upper chamber communicating with both the insulating compartment and with the lower chamber, the lower chamber communicating with only the upper chamber so that the water absorber prevents water vapor in the insulating compartment from reaching the getter material.